REMARKS

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow.

Claim 1 is currently being amended.

This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

After amending the claims as set forth above, claim 1 is now pending in this application.

Information Disclosure Statements

Applicant acknowledges receiving a signed copy of the PTO/SB/08 form submitted with the Information Disclosure Statement filed June 12, 2009.

Applicant notes that an Information Disclosure Statement and PTO/SB/08 form were submitted on March 10, 2010. Applicant respectfully requests that the next Office correspondence include a signed and initialed copy of the PTO/SB/08 form.

Claim Objection

Claim 1 is objected to for containing informalities. Applicant has viewed the electronic copy on PAIR of the claim amendments submitted with the previous response. This scanned electronic copy of the claims appears to be of low quality because the word "second" in the last line of the first page of the claim amendments and the word "heat" in the last line of claim 1 may appear to instead be "sccond" and "hcat" because the letters "e" in each word are fully scanned. However, upon close inspection one can see that these words do contain the letter "e."

Applicant notes that the amendments to the claims render the objection regarding "sccond" moot. Applicant has not amended the last line of claim 1 because the claim language submitted by Applicant did not include "hcat."

Reconsideration and withdrawal of this objection is respectfully requested.

Rejections under 35 U.S.C. § 112

Claim 1 is rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the written description requirement. Claim 1 is rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite and allegedly being incomplete for omitting essential elements. Applicant respectfully submits that the amendments to claim 1 render these rejections moot. Reconsideration and withdrawal of these rejections is respectfully requested.

Rejection under 35 U.S.C. § 103

Claim 1 is rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 5,006,178 to Bijvoets (hereafter "Bijvoets") in view of U.S. Patent No. 5,515,683 to Kessler (hereafter "Kessler"). Applicants respectfully traverse this rejection for at least the reasons set forth below.

Applicant respectfully submits that one of ordinary skill in the art would not have looked to the device of Bijvoets because one of ordinary skill in the art would understand that the device of Bijvoets does not function as a thermoelectric device, as will be discussed below. The Office argues on page 6 of the Office Action that the device of Bijvoets "reads on" the claimed invention. However, as noted on page 5 of the Office Action, Bijvoets does not disclose or suggest all of the features of claim 1.

Applicant is not arguing that Bijvoets teaches away or otherwise disparages the claimed invention in the context of an anticipation rejection, in which such arguments may not be relevant to whether a single reference actually discloses all of the features of a claimed invention. As noted on pages 3-5 of the Office Action, this rejection is an obviousness rejection, not an anticipation rejection. Because this is an obviousness rejection and not an

anticipation rejection, different considerations arise that do not arise in the context of an anticipation rejection, such as the scope and content of the prior art, any differences between a claimed invention and the prior art, and the level of ordinary skill in the art. See MPEP § 2141, Part II, *citing Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966).

Office personnel fulfill a role of factfinder when resolving these basic factual inquires by providing findings of fact concerning the state of the art to support a legal conclusion of obviousness. See MPEP § 2141, Part II. In other words, obviousness does not only involve whether all of the features of a claimed invention can be found in the prior art. In addition, one must have a rationale for why one of ordinary skill in the art would have combined the teachings of references and thus why a claimed invention would have been obvious. See generally MPEP § 2143. For at least the following reasons, one of ordinary skill in the art would have understood that Bijvoets makes technically incorrect statements and that the device of Bijvoets does not function as a thermoelectric device. As a result, one of ordinary skill could not have a rationale to support a conclusion that it would have been obvious to modify the device of Bijvoets by the teachings of Kessler to provide a thermoelectric apparatus, as recited in claim 1, because of the technical deficiencies of Bijvoets. Instead, one of ordinary skill in the art, understanding that the device of Bijvoets does not function as a thermoelectric device, would have looked to teachings and references other than Bijvoets.

In column 4, lines 24 to 29, Bijvoets discloses that "[t]he thickness of the end pieces 8, 10 is in the order of magnitude of several μm and they may consist of the usual semiconductor material, such as BiTe. Said thickness of the layer is about 0.1% of the conventional length of the element half, as a result of which the losses W2 of Joule heat of the semiconductor material are reduced by the same order of magnitude." Applicant submits that the foregoing statement of Bijvoets leads to adverse effects in terms of thermal conduction, i.e. heat flux due to thermal conduction W3 in equation (3) of Bijvoets, as discussed below.

It is a well known physical fact that the thermal conductivity of copper, such as that used for the intermediate pieces 9 of Bijvoets, is about 400 [W/m/k], and the thermal conductivity of a Bi_2Te_3-based semiconductor, such at that used for the end pieces 8, 10 of

Bijvoets, is about 1.5 [W/m/k] at a normal temperature range about from 0°C to 100°C and is about 1/270 the thermal conductivity of copper.

When the current is flowing from left to right in the circuit shown in the drawing of Bijvoets, heat generation occurs at the junction between the end piece 8 and bridge 5, heat absorption occurs at the junction between the end piece 8 and the intermediate piece 9, heat generation occurs at the junction between the end piece 10 and the bridge 5, and heat absorption occurs at the junction between the end piece 10 and the intermediate piece 9, on the side closer to plate 3.

It is to be noted that according to equation (3) of Bijvoets, the quantity of heat transported due to thermal conduction W3 is inversely proportional to the thickness (or length) L. This yields the following equation.

(W3 of end piece 8, 10) / (W3 of intermediate piece 9)

= (about 1.5 [W/m/k] / several [μm]) / (about 400 [W/m/k] / several [mm])

≈3.7

The foregoing equation indicates that the heat flow quantity within end pieces 8 and 10 on the side closer to plate 3 in the drawing of Bijvoets is equal to about 3.7 times the heat flow quantity W3 within the intermediate pieces 9. As a consequence, a heat generation quantity at each junction between bridge 5 and end piece 8 and between bridge 5 and end piece 10 at the side closer to plate 3 in the drawing of Bijvoets and a heat absorption quantity at each junction between intermediate piece 9 and end piece 8 and between intermediate piece 9 and end piece 10 are mutually cancelled. This is true also for the side closer to plate 2 in the drawing of Bijvoets. As a result, even when the current is flowing, there occurs no temperature difference between the two bridges 5 on the sides closer to plates 2 and 3 in the device of Bijvoets. One of ordinary skill in the art would have understood that such a temperature difference would be a hallmark of a thermoelectric device and that this deficiency demonstrates that the device of Bijvoets does not function as a thermoelectric device.

In addition, Bijvoets states in column 3, lines 7 to 18, that "[b]ecause a P-conducting end piece 8 and an N-conducting end piece 10 are respectively connected at each bridge 5, the enhancement or depletion process of free electrons mentioned above will take place in the bridges 5 with the passage of current. As a result thermoelectric effects are created in the bridges 5, therefore. At both ends of the intermediate pieces 9 there is semiconducting material of the same conductivity type and there will be at least substantially no enhancement or depletion process. As a result hardly any or no thermoelectric effects at all are created in the intermediate pieces 9, therefore."

Applicant submits that any thermoelectric effects would actually occur at the intermediate pieces 9 in the device of Bijvoets. For example, when the current is flowing in the circuit from left to right, such as in the device shown in the drawing of Bijvoets, the current is flowing through a π type Peltier element closer to plate 3 in the order of components 9, 8, 5, 10 and 9. Thus, if heat generation occurs at the junction between the end piece 8 and bridge 5, heat absorption occurs at the junction between the end piece 8 and the intermediate piece 9, heat generation occurs at the junction between the end piece 10 and the bridge 5, and heat absorption occurs at the junction between the end piece 10 and the intermediate piece 9. When the current is flowing in the circuit in the reverse direction, heat absorption occurs at the junction between the end piece 8 and bridge 5, heat generation occurs at the junction between the end piece 8 and the intermediate piece 9, heat absorption occurs at the junction between the end piece 10 and the bridge 5, and heat generation occurs at the junction between the end piece 10 and the intermediate piece 9. Heat is conducted within the bridge 5 and within the intermediate piece 9, so that the temperatures of the bridge 5 and the intermediate piece 9 in a steady-state are determined in dependence upon the thermal capacities of the bridge 5 and the intermediate piece 9.

Bijvoets also discloses in column 4, lines 16 to 19, that "[a]ccording to the invention, however, intermediate pieces 9 are used which, dependent on the conductivity type of the end pieces 8 or 10, will behave as P-type or N-type material." Applicant, however, submits this is incorrect for the reasons that follow. Bijvoets specifies that the end pieces 8 and 10 are semiconductors, and the intermediate pieces 9 are made of a material having a high electrical conductivity such as a copper, as described in lines 7 and 8 of column 2 of Bijvoets and

recited in lines 44 to 46 of column 5 of Bijvoets. Semiconductors have a band-gap (forbidden band) in the energy band diagram, while a material having a high electrical conductivity such as a copper has no band-gap (forbidden band). Therefore, the intermediate pieces 9 never behave as P-type or N-type material. Because of these deficiencies, one of ordinary skill in the art would not have looked to the device of Bijvoets when considering combinations and/or modifications to produce a thermoelectric apparatus, as recited in claim 1.

Additionally, Bijvoets generally states from column 1, line 45, to column 2, line 31, that the semiconductor pieces are shortened, and an electrical conductor made of copper or the like having a negligible thermoelectric effect and a negligible electrical resistivity as compared with the semiconductor piece is used as an intermediate piece electrically connecting at both ends the semiconductor pieces to each other, so as to reduce a Joule heat due to electrical resistance and to enhance an efficiency of thermoelectric conversion. However, Bijvoets seems to incorrectly try to demonstrate technological, physical, and functional advantages of the disclosed thermoelectric device, only paying attention to the intermediate piece having the small electrical resistivity and connecting the semiconductor pieces at both ends. It is however true that, when attention is paid to physical phenomena which occur in the entire thermal electric conversion circuit of the thermoelectric device of Bijvoets, including the semiconductor pieces at both ends and the intermediate piece, the efficiency of the thermoelectric conversion circuit according to that thermoelectric device is instead reduced due to the addition of the Joule heat loss at the intermediate pieces.

For example, in column 5, lines 5-15, and Example I of Bijvoets the length of Bismuth Tellurium (BiTe) based semiconductor end pieces 8 (P-type) and 10(N-type) are respectively equal to about 2.5 mm. Here, the total length of the pair of end pieces top portion 8 and bottom portion 8 (or top portion 10 and bottom portion 10), which is equal to about 5 [mm], is approximately the same as the length of semiconductor piece P (or N) of a Peltier module typically available on the market. It is true that when the current flows in the circuit including the intermediate pieces 9 shown in the drawing of Bijvoets, the Joule heat loss at the intermediate pieces 9 are added to increase the whole Joule heat loss of the device, as compared with the case where intermediate pieces 9 are not present. Unless intermediate pieces 9 are in a superconductor state, a physical phenomenon is impossible, in which the

current is flowing through intermediate pieces 9, the Joule heat loss at intermediate pieces 9 is equal to zero. The electrical resistivity of a semiconductor, provided at normal temperatures, is dependent upon the temperature. A temperature at which even a high temperature superconductor now developed is brought to be in a superconductive state is considerably lower than normal temperatures. Applicant submits that the foregoing statements of Bijvoets are incorrect from technological, physical, and functional viewpoints.

Kessler teaches two different Peltier elements connected in a circuit, but does not provide any structure for the conductive members of the elements. For example, Kessler generally shows, in Fig. 5, a construction that a Peltier element circuit where two Peltier elements (1, 2) having different capacities are serially connected is provided with a bypass diode (10) for reducing a thermal load that is applied to a Peltier element having a smaller capacity during heating operation. However, the device of Kessler does not resolve the fundamental deficiencies in Bijvoets.

For at least the reasons discussed above, Applicant respectfully submits that one of ordinary skill in the art would not have made the combination argued by the Office or looked to the teachings of Bijvoets in the first place. For these reasons, one of ordinary skill in the art would not have relied upon Bijvoets to conclude that the thermoelectric apparatus of claim 1 was obvious over Bijvoets and Kessler because of the deficiencies of Bijvoets. Reconsideration and withdrawal of the rejection is respectfully requested.

Double Patenting

The Office sets forth form paragraphs for the case law and rules supporting a nonstatutory obviousness-type double patenting rejection but does not set forth a nonstatutory obviousness-type double patenting rejection. Applicant respectfully submits that the nonstatutory obviousness-type double patenting rejection set forth in the previous Office Action was rendered moot by the Terminal Disclaimer filed with Applicant's previous response. Applicant respectfully requests the Office to verify that the nonstatutory obviousness-type double patenting rejection has been withdrawn in the next Office correspondence.

Conclusion

Applicant submits that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing or a credit card payment form being unsigned, providing incorrect information resulting in a rejected credit card transaction, or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicants hereby petition for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date April 8, 2010 By _____

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